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National Aeronautics and
Space Administration

**ATTACHMENT J-1
TO
SOLICITATION NNNK09280440R**

**LAUNCH CONTROL SYSTEM
CONSOLE ENCLOSURE ACQUISITION
SPECIFICATION**

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ABBREVIATIONS AND ACRONYMS

Units of measure and some terms commonly understood within the subject disciplines have been abbreviated in the body of this document without callout but are included among the following.

ANSI	American National Standards Institute
BTU	British Thermal Unit
BTU/Hr	British Thermal Unit per Hour
C	centigrade
C&C	Command and Control
CCC	Command, Control, and Communications
cm	centimeter
COMM	Communications (Subsystem)
CxP	Constellation
dB	decibel
dBA	Decibel, A-weighted
ECA	Electronic Components, Assemblies and Materials Association
EIA	Electronic Industries Alliance
EMI	electromagnetic interference
GFE	Government-furnished equipment
GHz	gigahertz
HF	Human Factors
HVAC	Heating, Ventilating, and Air Conditioning
kg	kilogram
KSC	Kennedy Space Center
LCS	Launch Control System
MHz	megahertz
NEMA	National Electrical Manufacturers Association
OE	Operations Engineering
OIS	Operational Intercommunication System
OTV	Operational Television
PDC	Power Distribution Chassis
RF	radio frequency
RETMA	Radio Electronics Television Manufacturers Association

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RU	rack unit
STD	standard
TBD	to be determined
TM	Test Management
V/m	volts per meter
VAC	volts alternating current
VESA	Video Electronics Standards Association

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1 INTRODUCTION

1.1 Purpose

The purpose of this document is to describe the technical design requirements associated with the Console Enclosures of the NASA KSC Launch Control System (LCS).

2 DOCUMENTS

2.1 Reference Documents

The following documents contain supplemental information to guide the user in the application of this document. In addition, documents which are specifically referenced in the rationale herein will be listed in this table.

Document Number	Title	Version
NFPA 70	National Electrical Code	2008 Edition
ECA EIA/ECA-310-E	Cabinets, Racks, Panels, and Associated Equipment	Rev E
FED-STD-595	Federal Standard Colors Used in Government Procurement	Rev C

3 OPERATIONS ENGINEERING, TEST MANAGEMENT, AND WEDGE ENCLOSURE DESIGN

3.1 Description

The LCS Enclosures provide a modular mounting system for writing surfaces, display devices, panel-mounted equipment, computer workstations, communications equipment, cabling, and internal power distribution. The enclosures are designed specifically for mission critical operations that emphasize operator ergonomics and ease of access to equipment. They support a design that facilitates situational awareness for multiple operators.

LCS Console Enclosures include:

- Operations Engineering (OE)
- Test Management (TM)
- Operations Engineering Mini (OE-Mini)
- Test Management Mini (TM-Mini)
- Wedges

Each of these designs carefully considers reach and equipment placement to improve operator comfort and flexibility. All enclosures recognize persons with disabilities and human factors guidelines.

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The enclosures are designed to accommodate operational and technological changes and provide the capability for equipment interchangeability, assembly or replacement on-site.

The base design accommodates various equipment and system requirements including workstation towers, network patch panels, cable management, power distribution, and equipment grounding. Depending on placement in a facility, equipment is accessible from both the front and rear for servicing and upgrades. The base also provides EMI shielding.

The hood and desktop design accommodate workstation displays, keyboards and mice, desktop speakers, IT Security card readers, network and power connectivity for laptop computers, panel-mounted equipment, and telephones. In addition, the hood provides a sound barrier.

Console enclosures are constructed so that desktops do not move independently when two or more enclosures are connected together. Enclosures accept Wedges that allow series mounted enclosures to be connected together and Extended Wedges for additional desktop work space.

3.2 OE/TM Enclosures

3.2.1 General

OE and TM Enclosures shall consist of an independent base, hood, and desktop. Modular construction allows for transport and assembly in Control Room applications throughout the LCS. OE and TM Enclosures shall be the same physical size with the ability to interchange panel-mounted equipment and alter the amount of rack-mount space. This allows the OE and TM Enclosures to share a common design. All enclosures shall have assembly and sub-assembly part numbers.

OE/TM Enclosures shall accommodate computer workstations, voice and video communications equipment, internal power distribution, and provide external power and network connectivity for remote computing for Systems Engineers.

OE/TM Enclosures shall accommodate up to four workstations and four flat panel displays. Nineteen inch (19") RETMA standard rack-mount space as defined by EIA ANSI/EIA-310 shall be available in two rack unit (2RU) to fourteen rack unit (14RU) configurations in up to four locations along the hood. The primary difference between enclosure configurations shall be the size of the RETMA chassis installed and the quantity of monitors supported. Modular construction allows multiple RETMA and monitor configurations. The space between the hood and desktop constrains configurations. A large rack-mount space limits the number of displays that can be installed.

OE/TM Enclosures shall be designed to be freestanding using removable supports and shall not require physical securing to the floor or under floor substructure. OE/TM Enclosures shall be designed to stand alone, be attached directly together in a straight line, or be attached together using Wedges. Wedges shall be available as straight or angled to form a curve. In addition, Extended Wedges shall add another foot of desktop space to the front of the enclosure. All enclosures shall be accessible from both front and rear and designed for placement as close as two inches (5.08 cm) from the wall.

Figure 3.2-1 depicts an OE/TM Enclosure concept configured for Operations Engineering.

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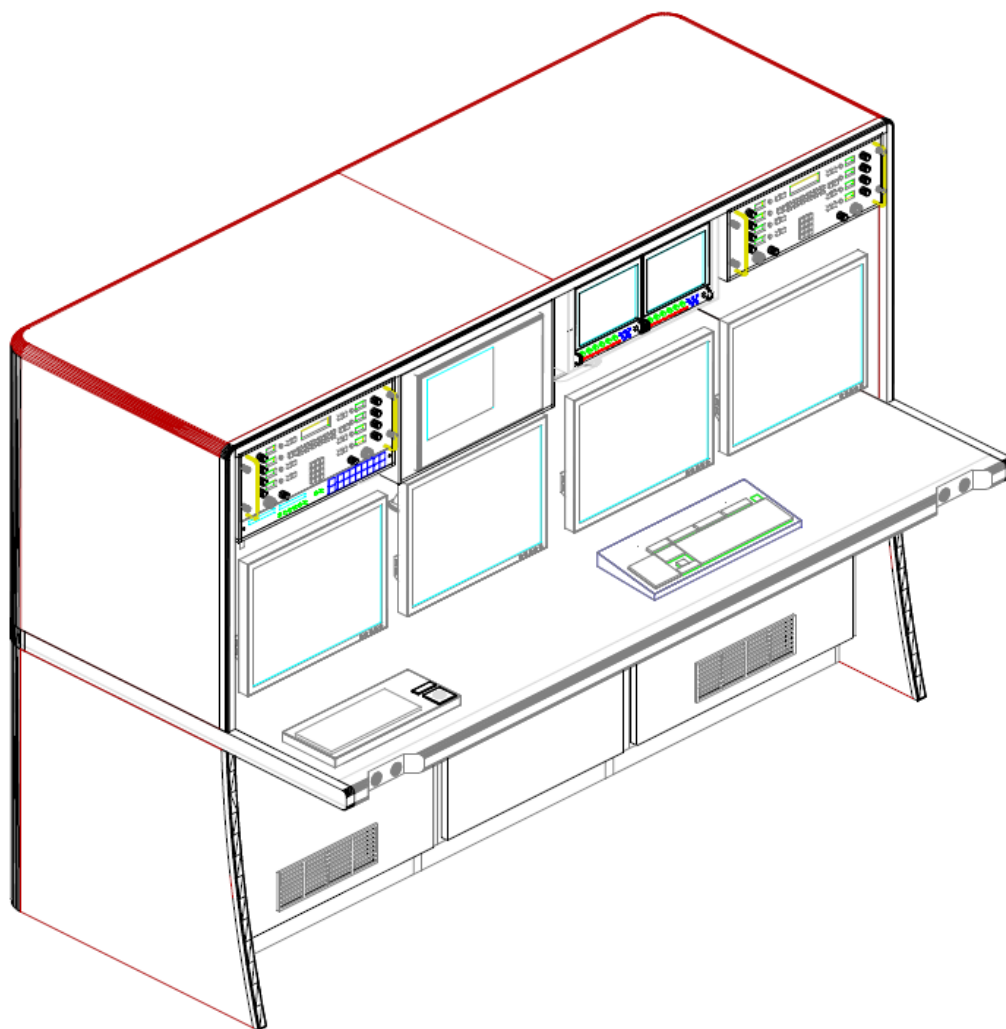


Figure 3.2-1 OE/TM Enclosure Concept Configured for Operations Engineering

Figure 3.2-2 depicts and OE/TM Enclosure concept configured for a Test Director.

OE/TM-Mini Enclosures shall share the same physical characteristics and architectural features as OE/TM Enclosures but be only half as wide, accommodate up to two workstations, two displays, and two 19" RETMA standard rack-mount spaces in two rack unit (2RU) to fourteen rack unit (14RU) configurations.

Figure 3.2-3 depicts an OE/TM-Mini Enclosure concept configured for the Chief Engineer.

3.2.1.1 General Dimensions and Ergonomic Characteristics

OE/TM Enclosure dimensions and architectural features have been established based on support equipment requirements, launch vehicle system quantities, the ability for console users to see over the enclosure, and available floor space in KSC Control Rooms. Dimensions have been validated through mock-up evaluations, design team analysis, and user reviews. OE/TM Enclosure general dimensions are as follows.

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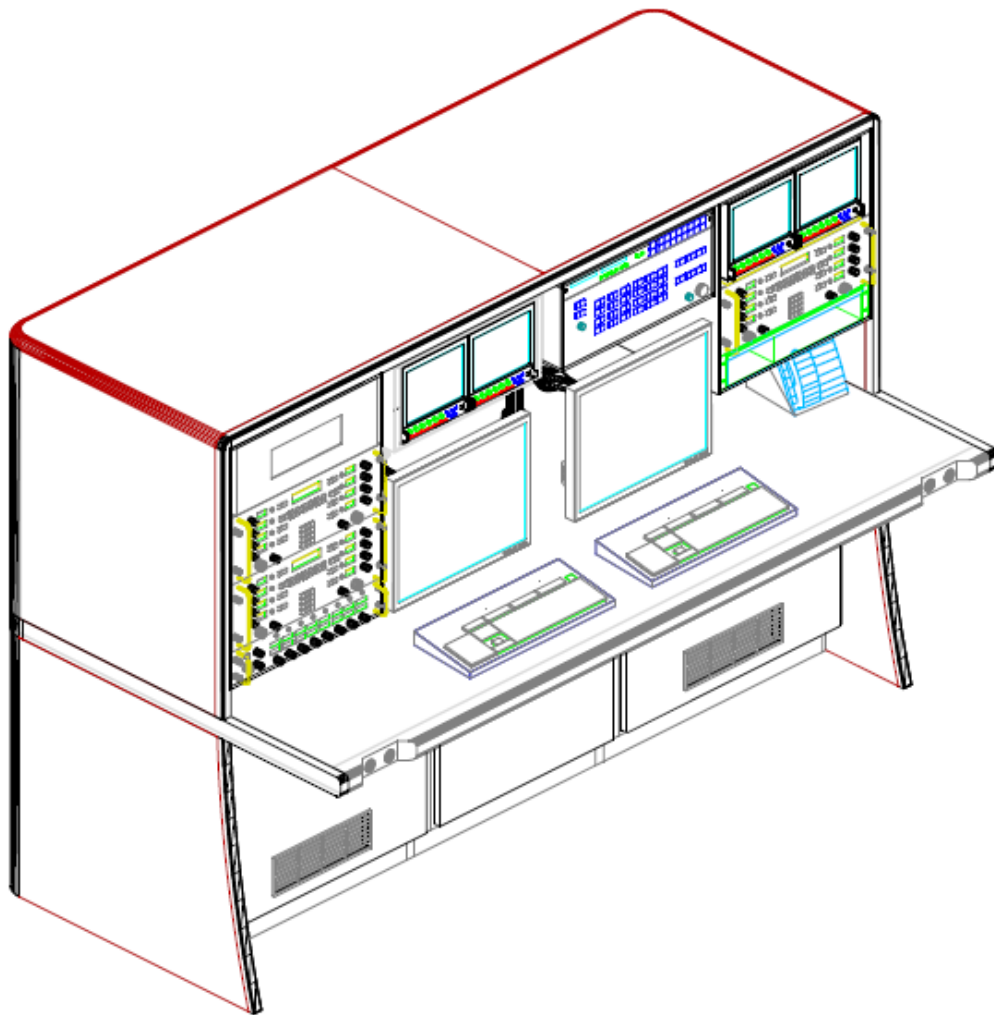


Figure 3.2-2 OE/TM Enclosure Concept Configured for a Test Director

OE/TM Enclosure

- Maximum Height shall be 60 inches (152.4 cm).
 - Preferred Height is 59 inches (149.86 cm).
- Maximum Width shall be 84 inches (213.36 cm).
- Maximum Depth shall be 44 inches (111.76 cm).
- Maximum Desktop Height shall be 29.5 inches (74.93 cm).
 - Preferred Desktop Height is 29 inches (73.66 cm).
- Desktop Leading Edge to Hood shall be 15 inches (38.10 cm).

OE/TM-Mini Enclosure

- Maximum Height shall be 60 inches (152.4 cm).

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- Preferred Height is 59 inches (149.86 cm).
- Maximum Width shall be 42 inches (106.68 cm).
- Maximum Depth shall be 44 inches (111.76 cm).
- Maximum Desktop Height shall be 29.5 inches (74.93 cm).
 - Preferred Desktop Height is 29 inches (73.66 cm).
- Desktop Leading Edge to Hood: 15 inches (38.10 cm)

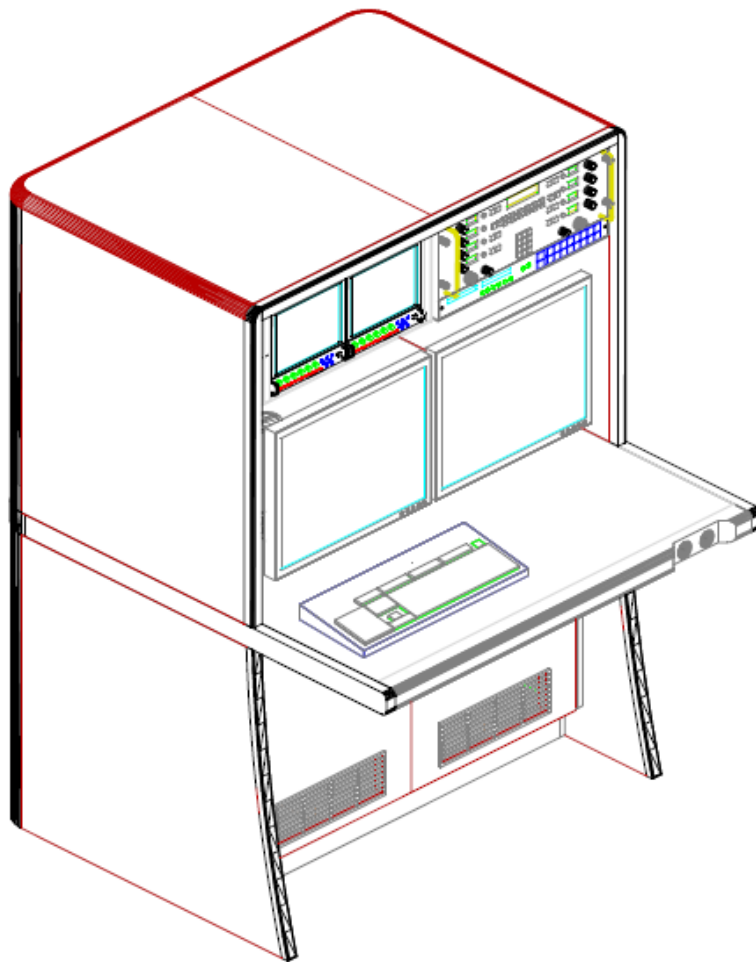


Figure 3.2-3 OE/TM-Mini Enclosure Concept Configured for the Chief Engineer

Key human factors guidelines reflected in the OE/TM Enclosure design are as follows and depicted in **Figure 3.2-4**.

- Knee Space (floor to bottom of desktop) shall be ≥ 27 inches (68.58 cm).
- Knee Space (desktop leading edge to base) shall be ≥ 18 inches (45.72 cm).
- Toe Space Depth (from desktop leading edge) shall be ≥ 20 inches (50.8 cm).

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- Toe Space Height (at base) shall be ≥ 3.5 inches (8.89 cm).

Other human factors considered in the design include distance to displays, visibility when standing, and equipment reach. There shall be no protrusions or obstructions below the desktop that would interfere with or injure the seated user.

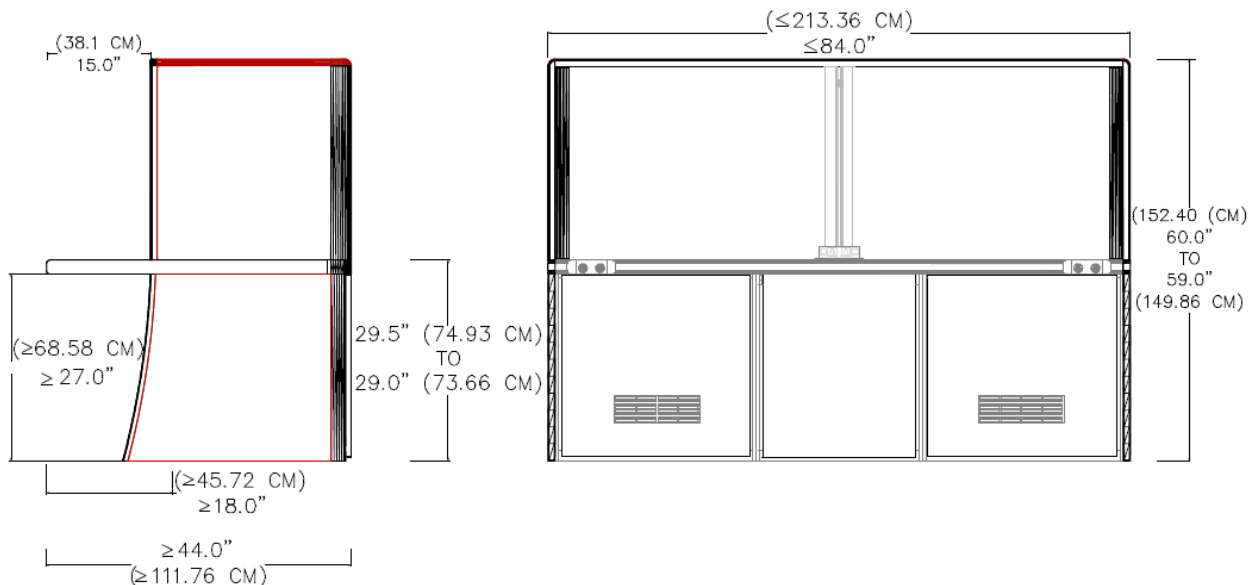


Figure 3.2-4 OE/TM Enclosure General Dimensions

3.2.1.2 Materials, Finishes, and Workmanship

OE/TM Enclosures shall be finished metal and high quality laminates with no exposed, unfinished wood on any enclosure interior or exterior surface. Metals used in construction of the enclosures shall be non-corrosive or treated to resist corrosion. External surfaces shall be washable, resistant to mild abrasion, and not subject to damage by common liquid spills or common cleaning agents. Parts, such as hinges, catches, handles, or knobs shall be assembled in such a manner as to avoid damaging hardware or surfaces. When standard industrial tape has been adhered to/removed from any painted surface, no paint shall be removed. Enclosures shall match the color scheme for Firing Rooms as selected by NASA and convey an “executive” appearance.

Laminates used in the construction of the enclosures shall be high pressure. Painted metal surfaces shall be powder coat or baked enamel, flat sheen.

Enclosures shall be fabricated and finished so appearance, fit, and adherence to specified dimensions and tolerances are observed and in a manner that ensures reliable operations in accordance with the requirements specified herein. Particular attention shall be given to the neatness and thoroughness of construction and to the freedom of parts from burrs and sharp edges that might damage associated equipment or cause injury to personnel.

3.2.1.3 Colors

- Laminates shall be Wilsonart “Wild Cherry” #7054-60 or similar.

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- Hood
- Base Side Panels
- Work surfaces shall be Wilsonart “Cloud Zephyr” #4856-60 or similar.
- Exposed metal solid surfaces shall be Black FED-STD-595 #17038 or similar.
- End caps, trim, and grill surfaces shall be Black FED-STD-595 #17038 or similar.

Figures 3.2-5 and 3.2-6 depict an OE/TM Enclosure in applicable color scheme.

3.2.1.4 Displays

OE/TM Enclosures shall accommodate up to four workstations and four flat panel displays. The quantity of displays is based on console functionality. A typical OE Enclosure has two workstations and four flat panel displays. A typical TM Enclosure has two workstations, two flat panel displays, and additional RETMA mounting area above the desktop.



Figure 3.2-5 OE/TM Enclosure Color Scheme (Front View)

Workstation displays have Video Electronics Standards Association (VESA) mounting capability. All displays shall be mounted to the enclosure using fixed height, non-rotating

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(landscape only) monitor arms. The monitor arms shall provide user adjustable tilt, swivel, and horizontal articulation. To preserve space for documentation and keyboards, installed displays shall be approximately 3 inches (7.62 cm) above the desktop at 90 degrees and no less than 2 inches (5.08 cm) above the desktop when fully tilted. Monitor arm mounting may be by pole, slat board, or other mounting scheme as proposed by the enclosure manufacturer. Monitor arms and/or mounting structure shall be removable to enable enclosure reconfiguration. Monitor arm mounting structure shall not interfere with RETMA enclosures above the desktop.

With panel-mounted equipment above the displays and keyboards below, workstation display external dimensions are limited to 14"H X 19"W X 3.5"D (35.56 cm H X 48.26 cm W X 8.89 cm D) without stand. The maximum display weight is 18 pounds (8.16 kg).



Figure 3.2-6 OE/TM Enclosure Color Scheme (Rear View)

Monitor arm design criteria are as follows:

- Mounting Location (from desktop leading edge to monitor mount leading edge) shall be \geq 29 inches (73.66 cm).
- Display Articulating Motion shall be \leq 14 inches (35.56 cm) from desktop leading edge to \geq 26 inches (66.04 cm) from the desktop leading edge.

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- Display Height Range shall be 7 inches (17.78 cm) to 12 inches (30.48 cm) from the desktop measured from desktop to the center of monitor plate, adjustable in ≤ 0.125 inch (0.3175 cm) increments.
- Monitor Arm Deflection shall be ≤ 0.5 inch (1.27 cm) w/21 pound (9.5 kg) load.
- Cable Management – Monitor arms shall provide cable management so cables are hidden from view and can move undamaged with the display.
- Display Mounting Knobs shall be “knurled” or equivalent to allow displays to be easily removed from the front.

Figure 3.2-7 depicts the Monitor arm design criteria.

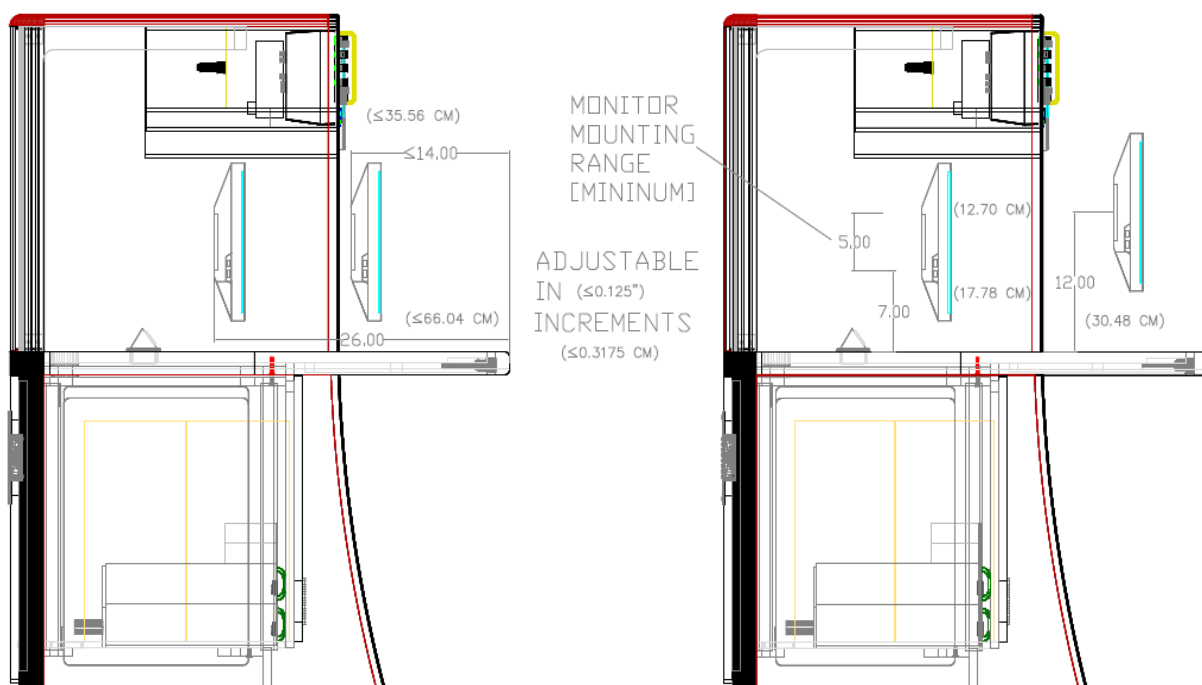


Figure 3.2-7 Monitor Arm Design Criteria

3.2.2 Base

3.2.2.1 General

All enclosures shall have a base. The base shall be designed using a “bay” concept to allow for partitioned equipment placement below the desktop and concealed from the console user. Depending on configuration, the enclosure base houses CWS and/or SWS workstation towers, network and communications patch panels, satellite network switches, power distribution units, and power strips. Bases shall be finished metal and constructed in a manner which provides electromagnetic interference (EMI) attenuation in accordance with **Table 3.2-8** with ventilation and cable penetrations. Exposed holes and penetrations not used for a particular configuration shall be sealed or plugged for aesthetic purposes and to maintain EMI shielding. Enclosure

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bases shall be of sufficient structural rigidity to avoid separation of seams and joints during normal transportation and installation.

Frequency Range	Minimum Attenuation
2 MHz – 144 MHz	12 dB
144 MHz – 10 GHz	20 dB
10 GHz – 18 GHz	12 dB

Table 3.2-8 EMI Attenuation Design Environment

Enclosure bases shall provide a stainless steel ground stud 0.25 inch (0.635 cm) diameter by 1 inch (2.54 cm) in length with 20 threads per inch in the bottom inside rear of each cabinet for connection to facility ground. The bases shall provide internal cable management, EMI shielded cable penetrations through the desktop and below floor, and cabinet ventilation. Low noise fans in the rear or ducted through the hood, and ventilation grids in the front of the base shall provide for equipment cooling.

Equipment installed in the base is designed to operate in an air conditioned environment with ambient room temperatures between +60° F (+15.6° C) to +80° F (+26.7° C) with extremes of uncontrolled temperatures between 52° F (11.1° C) and 95° F (35.0° C) for one (1) hour. Facilities in which the enclosures reside have Heating, Ventilating, and Air Conditioning (HVAC) systems that provide an ambient temperature controllable between 72° F (22.2° C) and 89° F (31.7° C) and relative humidity between 45% and 80%. Electronic equipment installed in the base generates approximately 2,500 BTU/Hr in heat load.

Audible fan/vent noise shall be limited to 35dBA sound pressure as measured one meter from the console enclosure.

Enclosure bases shall have lockable, removable front and rear access panels/doors for equipment access and servicing. Front and rear access provides floor plan flexibility allowing enclosures to be placed back-to-back or against a wall with two inch (5.08 cm) minimum separation. Base side panels shall match the hood color scheme and texture.

Enclosure base general dimensions are as follows.

- Minimum Height shall be 25.5 inches (64.77 cm).
- Maximum Depth w/Doors shall be 26 inches (66.04 cm).
- Minimum Inside Depth shall be 24 inches (60.96 cm).
- Minimum Inside Height shall be 22 inches (55.88 cm).

Bay size is dependent on enclosure configuration.

Cable routing shall be provided between all bays of an enclosure without affecting the EMI shielding. Each OE/TM Base bay shall provide a cable pathway to/through the desktop.

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3.2.2.2 OE/TM Base

At 84 inches (213.36 cm) wide, the OE/TM Base shall consist of three bays. Bays 1 and 3 accommodate two each workstation towers, not to exceed 19"H X 19"W X 9"D (48.26 cm H X 48.26 cm W X 22.86 cm D) each.

Bay 2 shall provide a minimum of eleven rack unit (11RU) of 19" RETMA standard rack-mount capability in the front of the bay and a minimum of 11RU in the rear for patch panels, switches, and power distribution. RETMA rail depth shall be adjustable. Rails shall be non-painted and provide continuous metal-to-metal contact to equipment mounted on rails.

With 11RU of rack-mount space and a minimum inside depth of 24 inches (60.96 cm), Bay 2 shall accommodate as a minimum, two (2) 2RU power distribution chassis's (PDCs) weighing 25 pounds (11.34 kg) each two (2) 1RU rack-mount power strips weighing 10 pounds (4.53 kg) each, a 1RU communication system patch panel weighing 2 pounds (0.90 kg) before cabling, and a 1RU network patch panel weighing 2 pounds (0.90 kg) before cabling.

Front and rear access panels/doors with a minimum 20 inch (50.8 cm) by 20 inch (50.8 cm) opening in each Bay shall facilitate equipment access, installation and removal.

OE/TM Base Bay general widths are as follows.

- Bay 1 Width shall be ≥ 27.0 inches (63.58 cm) and ≤ 30.5 (77.47 cm) inches.
- Bay 2 Width shall be ≥ 23.0 inches (58.42 cm).
- Bay 3 Width shall be ≥ 27.0 inches (63.58 cm) and ≤ 30.5 inches (77.47 cm).

Figure 3.2-9 depicts the OE/TM Base.

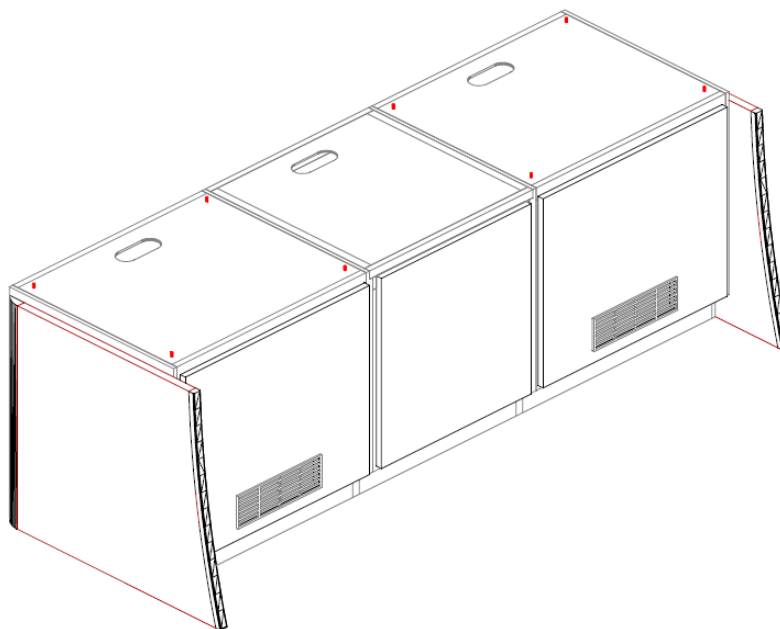


Figure 3.2-9 OE/TM Base Concept View

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3.2.2.3 OE-Mini/TM-Mini Base

OE-Mini/TM-Mini Base Bay general requirements are as follows.

- Dimensions shall be 42 inches wide (106.68 cm)
- Shall provide front and rear access panels/doors with a minimum 20 inch (50.8 cm) high by 36 inch (91.44 cm) wide opening
- Bay Storage shall accommodate two each computer workstation towers with dimensions not to exceed 19 inches H X 19 inches W X 9 inches D (48.26 cm H X 48.26 cm W X 22.86 cm D) each.
- The number of bays for the OE/TM-Mini Enclosure will be determined by the manufacturer.

Figure 3.2-10 depicts the OE/TM-Mini Base.

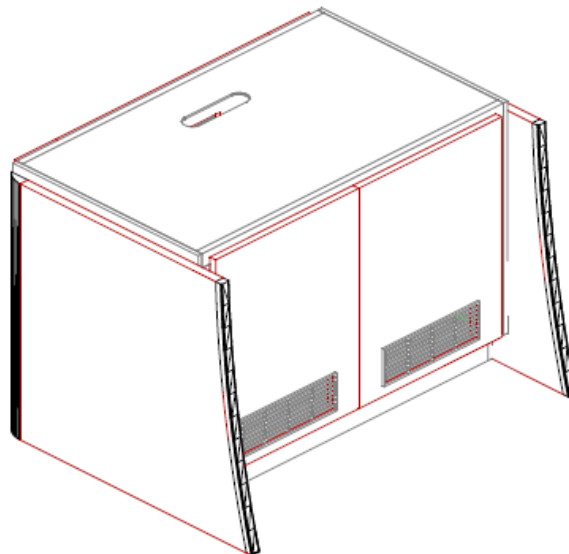


Figure 3.2-10 OE/TM-Mini Base Concept View

3.2.3 Hood

3.2.3.1 General Hood

All enclosures shall have a hood. The hood shall attach to the base/desktop and provide 19" RETMA standard rack-mount space in two rack unit (2RU) to fourteen rack unit (14RU) configurations in up to four locations using independently removable RETMA enclosures. A center mounted brace may provide stability and enable the hood to support the weight of rack-mounted equipment. The hood shall provide a sound barrier and hidden pathways for cabling to/from the base and desktop. Cable pathways shall extend up from the desktop to approximately 3 inches (7.62 cm) below the hood to allow for cables entering the hood mounted RETMA enclosures. Cable pathways shall be accessible from the front to allow for cable routing when a console is placed against a wall. Cable pathways shall be a minimum of two (2)

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inches (5.08 cm) deep by six (6) inches (15.24 cm) wide. Hidden cable pathways shall be provided for hood mounted telephones.

The shape of the hood is an important design consideration. To convey an “executive” appearance, the hood shall not have sharp edges or portray a “box” facade. The enclosure views depicted in this document represent one potential design concept utilizing large, rounded edges.

Modular construction shall allow multiple RETMA configurations. Rack-mount space is allocated for various combinations of the following KSC equipment.

- 4-Channel Operational Intercom System (OIS) Unit – (2RU)
- 8-Channel OIS Unit – (4RU)
- Operational Television (OTV) Display – (5RU)
- OTV Control Panel – (1RU)
- Paging and Area Warning System (PAWS) Unit – (4RU)
- Paging Panel - (1RU)
- Emergency Camera Control – (1RU)
- Dual Time Display – (1RU)
- Safing Panel – (4RU to 6RU)

RETMA enclosures shall accommodate equipment mounted on slides and be electrically grounded to the enclosure base. Bonding and grounding shall be provided in accordance with NFPA 70.

To accommodate changing requirements, RETMA enclosures shall be independently removable without removing the hood or other RETMA enclosures. RETMA enclosures shall be a minimum of 16 inches (40.64 cm) and no more than 18.5 inches (47 cm) deep.

Enclosure hoods shall provide for mounting telephone brackets on either side, both inside and outside the hood.

Enclosure hoods shall have removable rear access panels for equipment installation, removal, and servicing. The hood-mounted RETMA space shall also be accessible from the front. Front and rear access provides floor plan flexibility allowing enclosures to be placed back-to-back or against a wall.

Enclosure hood general dimensions are as follows.

- Minimum Height shall be 28.5 inches (72.39 cm).
- Maximum Height shall be 30 inches (76.2 cm).
- Depth shall be \geq 28 inches (71.12 cm).

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- Desktop Leading Edge to Hood Leading Edge shall be 15 inches (38.1 cm).
- Desktop Leading Edge to Hood Inside Wall shall be ≥ 38 inches (96.52 cm)
- Minimum Distance Desktop to Bottom of a 6RU Hood Mounted Enclosure shall be ≥ 18 inches (45.72 cm)

3.2.3.2 OE/TM Hood

The OE/TM hood shall be ≤ 84 inches (213.36 cm) wide and provide 19" RETMA standard rack-mount space in two rack unit (2RU) to fourteen rack unit (14RU) configurations in four locations. The OE/TM hood shall provide cable pathways for each base bay. When configured with a 14RU rack mount capability on the left and right sides, and two 6RU spaces in the middle, the OE/TM Hood shall be capable of supporting a 160 pound (72.57 kg) distributed load.

- A 14RU Rack Mount Space shall be capable of supporting 50 pounds (22.68 kg).
- A 6RU Rack Mount Space shall be capable of supporting 30 pounds (13.6 kg).

Figure 3.2-11 depicts the OE/TM Hood with no RETMA rack mount capability installed.

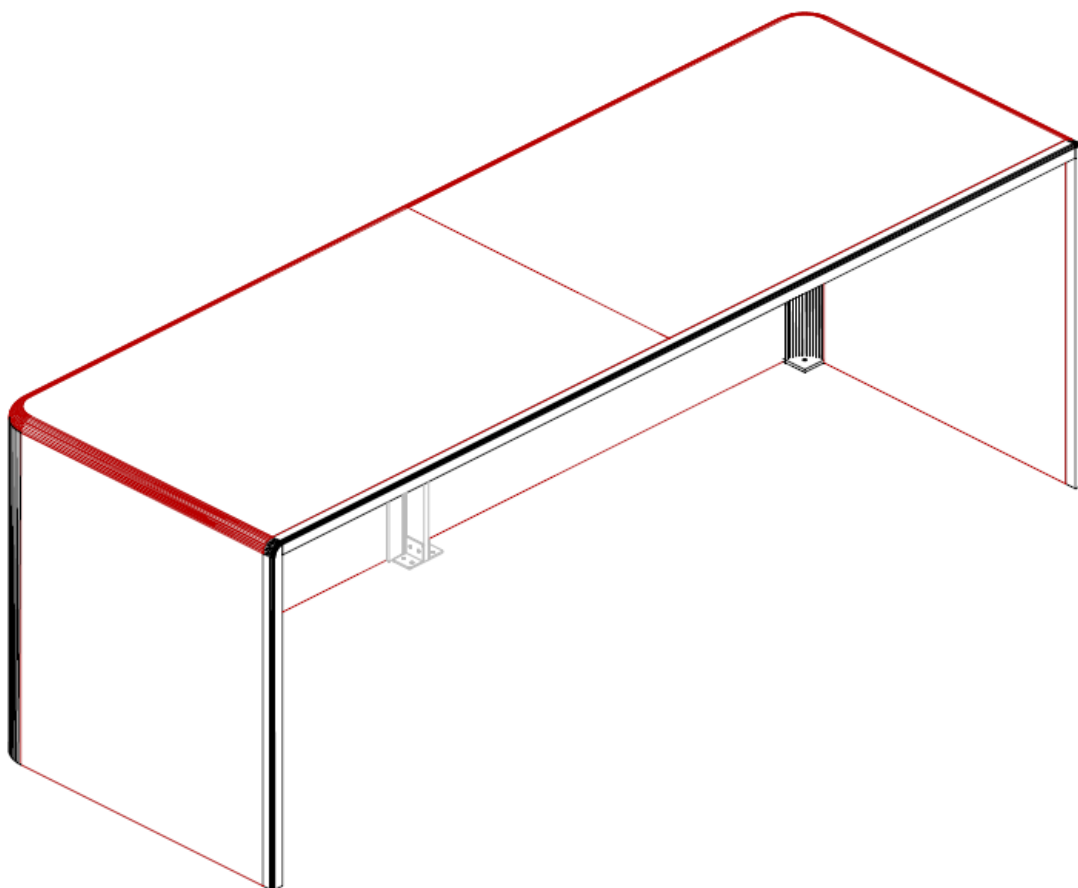


Figure 3.2-11 OE/TM Hood Concept View

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3.2.3.3 OE/TM-Mini Hood

The OE/TM hood shall be ≤ 42 inches (106.68 cm) wide and provide 19" RETMA standard rack-mount space in two rack unit (2RU) to fourteen rack unit (14RU) configurations in two locations. When configured with a 6RU rack mount capability on the left and right sides, the OE/TM-Mini Hood shall be capable of supporting a 60 pound (27.2 kg) distributed load.

Figure 3.2-12 depicts the OE/TM-Mini Hood with no RETMA rack mount capability installed.

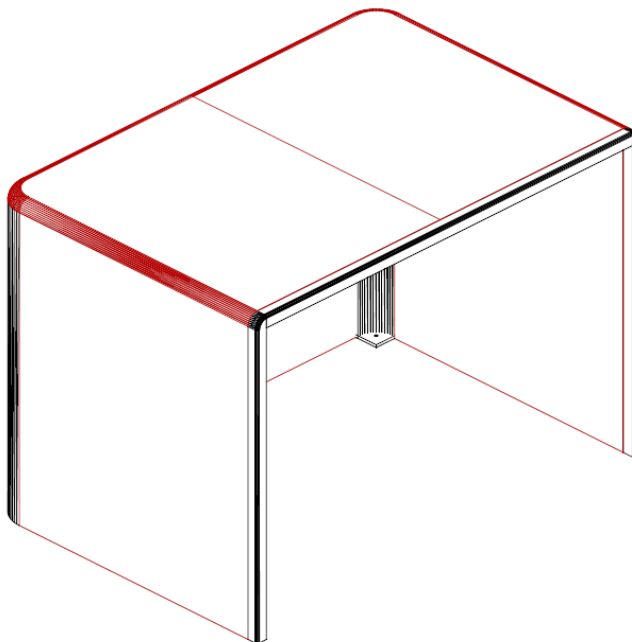


Figure 3.2-12 OE/TM-Mini Hood Concept View

3.2.4 Desktop

3.2.4.1 General Desktop

All enclosures shall have a desktop. The desktop shall attach to the base to accommodate workstation displays, keyboards and mice, desktop speakers, IT Security card readers, network data ports, power outlets, and laptop computers.

The desktop shall provide a support mechanism for pole or slat board mounted monitor arms and a pathway for cables entering the base through inset cutouts. Cable pathway cutouts shall be a minimum of 2 inches (5.08 cm) deep by 6 inches (15.24 cm) wide. The desktop shall provide cable pathways into each base bay.

Desktops shall be constructed so that two or more enclosures can be connected together using a Wedge peripheral. A standalone enclosure desktop shall be capable of carrying a 200 pound (90.72 kg) load at the front edge (center of span) with a maximum deflection of 0.250 inches (0.635 cm) when cantilevered and 0.230 inches (0.5842 cm) when supported. Extra support needed to meet these standards shall be accomplished without changing leg space or otherwise hindering operator's leg movement.

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The front edge of the desktop shall accommodate dual intercom system headset jacks including cabling. Installed headset cabling shall be in an enclosed pathway from the headset jacks into the rack mount space in the hood. There shall be no protrusions or obstructions below the desktop that would interfere with or injure the seated user. Desktop front edges shall be rounded at least 0.50 inches (1.27 cm). The desktop work surface shall be of seamless construction.

Enclosure desktop general dimensions are as follows.

- Overall Depth shall be ≤ 44 inches (111.76 cm).
- Desktop Leading Edge to Hood Leading Edge shall be 15 inches (38.1 cm).
- Useable Desktop Depth shall be ≥ 31 inches (78.74 cm).
- Thickness shall be 2 inches (5.08 cm) to 2.5 inches (6.35 cm).

3.2.4.2 OE/TM Desktop

The OE/TM Desktop shall be ≤ 84 inches (213.36 cm) wide and accommodates two dual intercom system headset jacks including cabling. Headset jacks shall be located on the left and right edges of the desktop with an optimum 2.75 inch (6.985 cm) offset from the end and embedded approximately 1.25 inches (3.175 cm) to 2 inches (5.08 cm) into the desktop.

The OE/TM Desktop shall provide two (2) fixed external network jacks and two (2) 110V NEMA 15R power outlets for user provided equipment. These connections shall be located in the center, near the rear of the desktop but accessible by users from the front. Electrical power receptacles and plugs shall be in accordance with NFPA 70.

Figure 3.2-13 depicts an OE/TM enclosure Desktop.

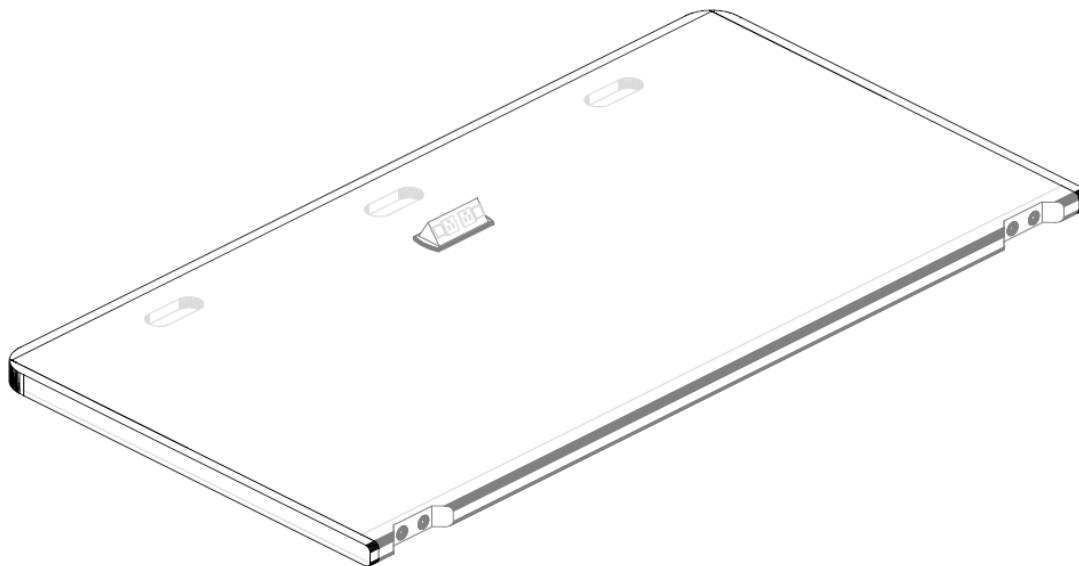


Figure 3.2-13 OE/TM Enclosure Desktop Concept View

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Figure 3.2-14 depicts a typical dual intercom system headset jack embedded in a desktop.

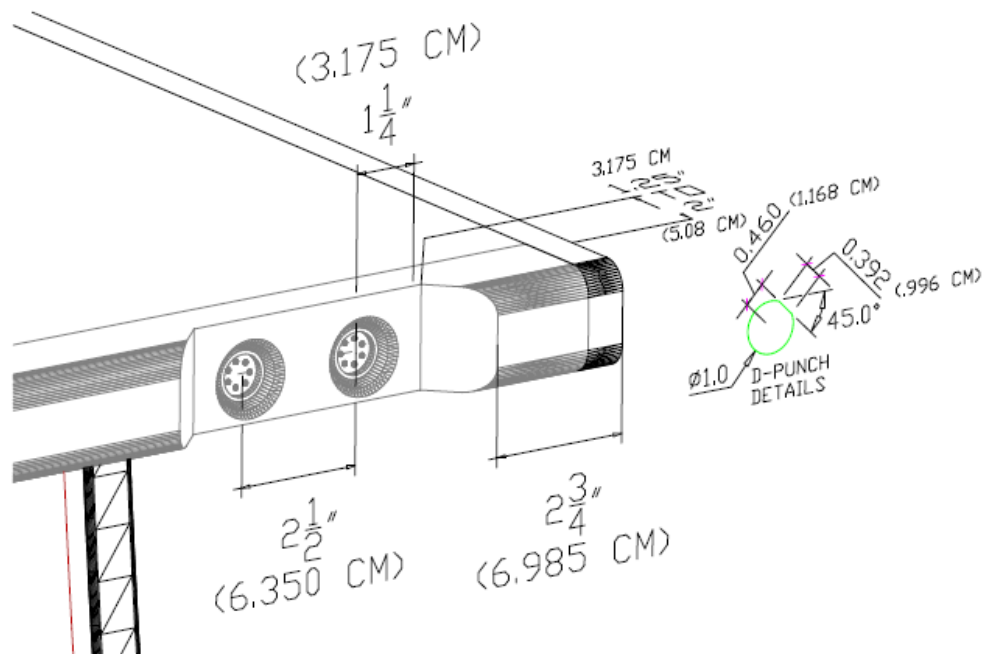


Figure 3.2-14 Desktop Dual Intercom System Headset Jack Concept View

3.2.4.3 OE/TM-Mini Desktop

The OE/TM-Mini Desktop shall be ≤ 42 inches (106.68 cm) wide and accommodates one dual intercom system headset jack including cabling, located on the right edge of the desktop with an optimum 2.75 inch (6.985 cm) offset from the end and embedded approximately 1.25 inches (3.175 cm) to 2 inches (5.08 cm) into the desktop.

The OE/TM-Mini Desktop shall provide two (2) fixed external network jacks and two (2) 110V NEMA 15R power outlets for user provided equipment. As in the OE/TM Enclosure, these connections shall be located near the rear of the desktop but accessible by users from the front. The network/power connections shall be located on the left side of the desktop.

Figure 3.2-15 depicts an OE/TM-Mini enclosure Desktop.

3.2.5 Wedges

Enclosures shall accept extension modules in the form of Wedges. Wedges shall connect OE/TM Enclosures together to form a straight or curved configuration. Wedges shall maintain the same desktop profile as the enclosures they link together.

Extended Wedges shall connect OE/TM Enclosures together and add another foot of desktop space in the front, between the two enclosures.

Wedges are peripheral enclosure components.

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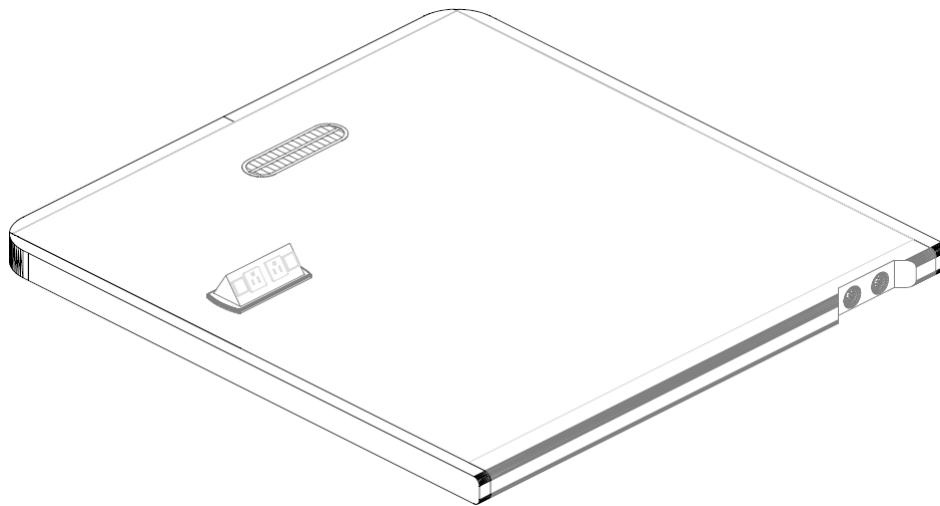


Figure 3.2-15 OE/TM-Mini Enclosure Desktop Concept View

3.2.5.1 Angle Wedges

An Angle Wedge shall consist of a base, desktop, and hood. Angle Wedge bases offer no EMI attenuation and are not designed to house equipment below the desktop. Angle Wedge desktops shall carry the same characteristics of OE/TM Enclosure desktops but do not accommodate integrated intercom system headset jacks or cabling. Angle Wedge hoods shall accommodate two standard telephone brackets with cable penetration. Angle Wedge hoods do not accommodate RETMA equipment.

Angle Wedge general dimensions are as follows.

- Maximum Height shall be 60 inches (152.4 cm).
- Minimum Width (Desktop Front) shall be 1 inch (2.54 cm).
- Maximum Depth shall be 44 inches (111.76 cm).
- Maximum Desktop Height shall be 29.5 inches (74.93 cm).
- Angle shall be 5 Degrees to 30 Degrees.

Figure 3.2-16 depicts two OE/TM Enclosures connected by a 5 degree Angled Wedge.

3.2.5.2 Straight and Extended Wedges

Straight and Extended Wedges shall consist of a base, desktop and hood. Wedge desktops shall have the same profile of adjacent enclosure desktops without headset jacks. Extended Wedge desktops extend up to 12 inches (30.48 cm) beyond adjacent desktops. Straight and Extended Wedges shall support an adjustable bookcase shelf and up to four telephone brackets. Wedges less than 12 inches (30.48 cm) wide are limited to two phones and do not support a bookcase shelf.

Straight Wedge general dimensions are as follows.

- Maximum Height shall be no taller than an OE\TM Enclosure.

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- Width shall be 5 inches (12.7 cm) to 24 inches (60.96 cm).
- Maximum Depth shall be 44 inches (111.76 cm).
- Desktop Profile shall conform to OE\™ Enclosure desktop profile.
- Angle shall be zero degrees (straight).

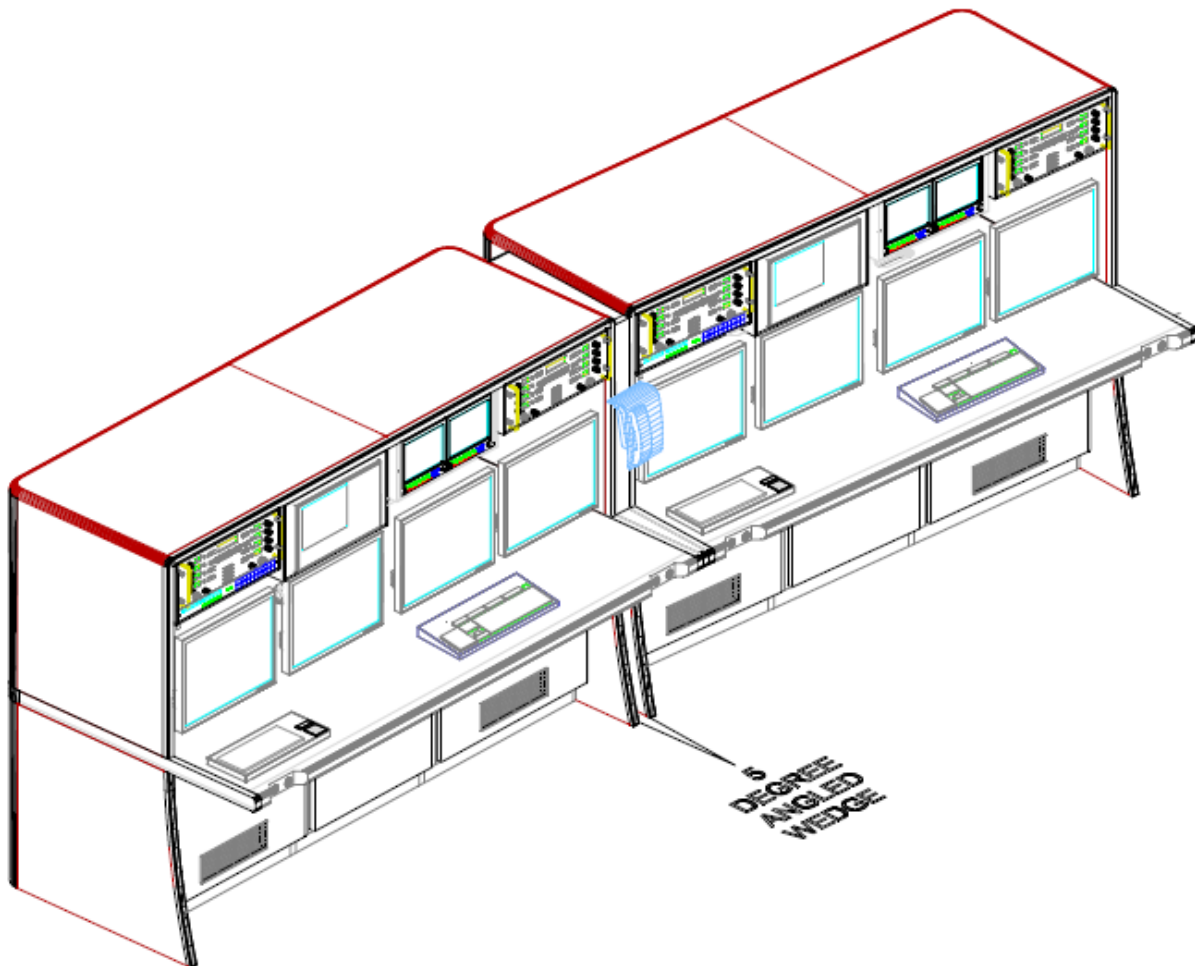


Figure 3.2-16 Angled 5° Wedge Concept View

Extended Wedge general dimensions are as follows.

- Maximum Height shall be no taller than an OE\™ Enclosure.
- Width shall be 12 inches (30.48 cm) to 24 inches (60.96 cm).
- Maximum Depth shall be 56 inches (142.24 cm).
- Desktop Profile shall conform to OE\™ Enclosure desktop profile while extending the desktop up to 12 inches (30.48 cm).

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- Desktop Corner Radius shall be ≥ 2 inches (5.08 cm).
- Angle shall be zero degrees (straight).

Figure 3.2-17 depicts the 5 inch (12.7 cm) version of a Straight Wedge.

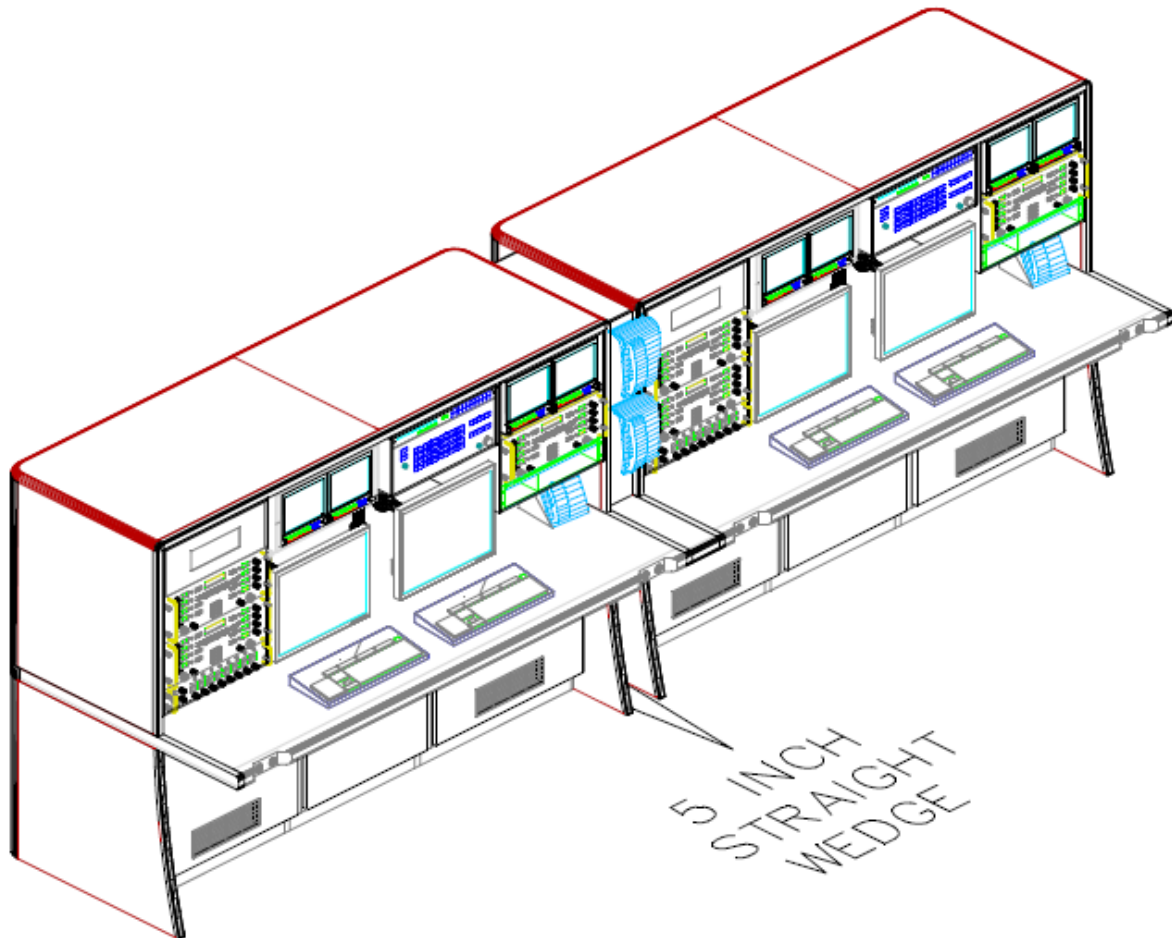


Figure 3.2-17 Straight 5" Wedge Concept View

Figure 3.2-18 depicts the 24" version of an Extended Wedge.

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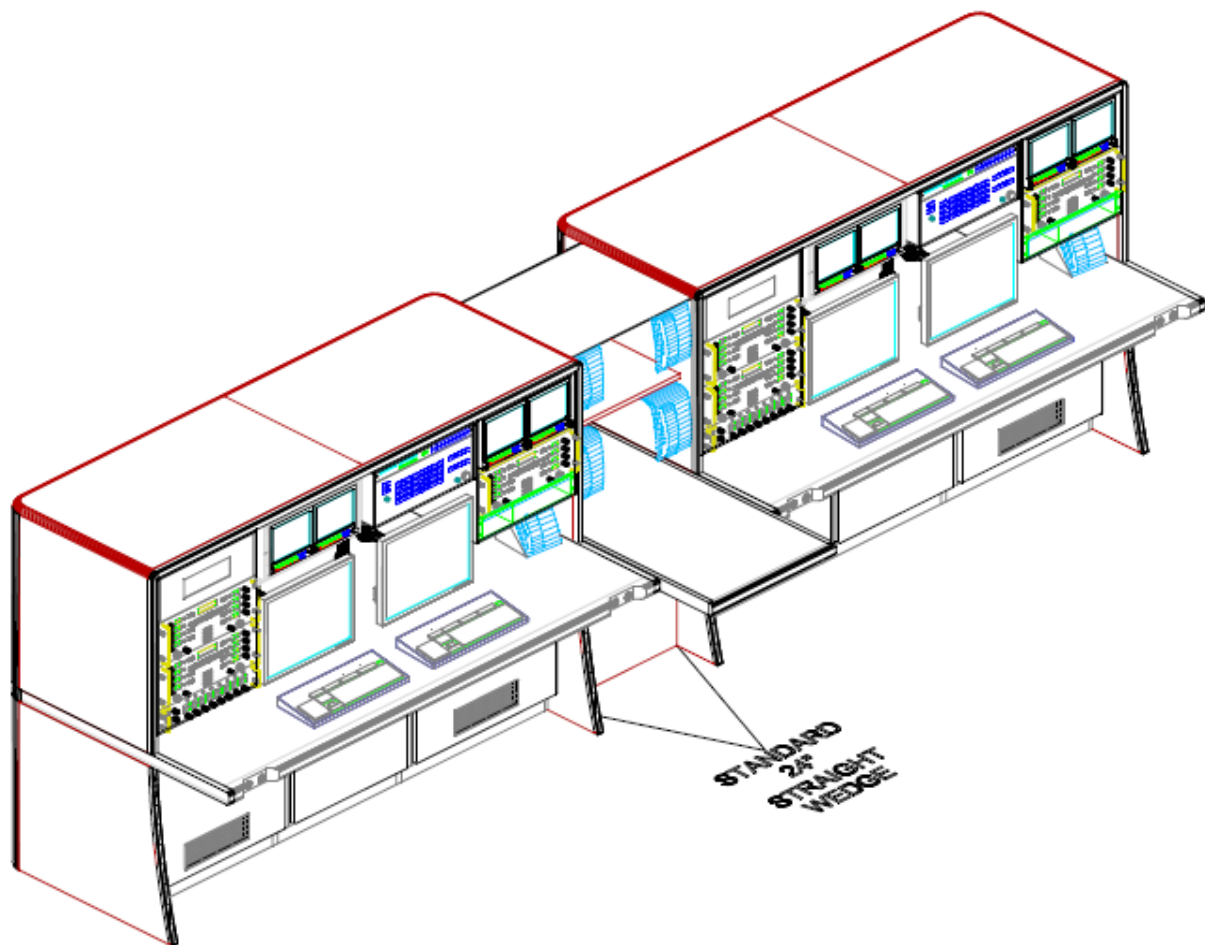


Figure 3.2-18 Extended 24" Wedge Concept View